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(72) Inventor: **Rudolf, Marian**
35700 Rennes (FR)

(71) Applicant: **Mitsubishi Electric Information
Technology Centre Europe B.V.**
1101 AG Amsterdam Zuidoost (NL)

(74) Representative: **Maillet, Alain**
SCP Le Guen & Maillet,
5, Place Newquay,
B.P. 70250
35802 Dinard Cedex (FR)

(54) **Method for allocating secondary synchronisation codes to a base station of a mobile telecommunication system**

(57) The present invention relates to a method for allocating secondary synchronization codes (SSC) to a base station of a mobile telecommunication system, each base station of said system continuously transmitting a primary synchronization code (PSC) and a set of K secondary synchronization codes (SSC) respectively allocated to the cell covered by said base station so that any mobile station, when getting switched on, can, on basis of the primary synchronization code (PSC) and the set of secondary synchronization codes (SSC) received from said base station, synchronize with at least one base station in order to read broadcast information, said system using only a predetermined and fixed number M of secondary synchronization codes (SSC) amongst all the N possible and available secondary synchronization

codes (SSC).

According to the invention, said method comprises the steps of calculating and evaluating the auto-correlation functions and/or cross-correlation functions of N possible secondary synchronization codes (SSC) and the primary synchronization code (PSC) and choosing the M secondary synchronization codes (SSC) amongst said N possible secondary synchronization codes (SSC) so that said the M chosen secondary synchronization codes (SSC) have at least one of the statistical properties of their auto-correlation function and cross-correlation function that is best in term of detection, and allocating a sub-set of said M secondary synchronization codes (SSC) comprising K secondary synchronization codes (SSC) to said base station.

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Description

[0001] The present invention relates to a method for allocating secondary synchronization codes to a base station of a mobile telecommunication system.

[0002] The present invention relates to a mobile telecommunication system comprising a number of base stations which can communicate with mobile stations. A communication from a mobile station to a base station is done by means of an up-link UL and the communication from a base station to a mobile station is done by means of a down-link DL.

[0003] The present invention relates also to a telecommunication systems wherein different user signals are separated both in time domain and in code domain. An example of such a system is the so called UMTS TDD system (Universal Mobile Telecommunication Systems - Time Division Duplex) or W-CDMA TDD system (Wideband Code Division Multiple Access - Time Division Duplex) in which the time domain is represented by the TDD-system component and the code domain by W-CDMA-system component.

[0004] More particularly, in time-domain, transmission is for example organized based on radio frames constituted of a number (for example 15) of timeslots. The same frequency is used for both the up-link (Mobile Station to Base Station) and the down-link (Base Station to Mobile Station). Furthermore, a time-separation is used to differentiate the down-link and the up-link such that a subset of all the available timeslots per frame is exclusively allocated for down-link transmission and the remaining ones for up-link transmission. In a frame, at least one timeslot is always allocated for each down-link and up-link.

[0005] In such a system, different user's signals can be transmitted in separate timeslots, e.g. N different down-link timeslots are allocated to N different down-link user signals. This is the time-division aspect of the system. Furthermore, several users signals can also be transmitted within one timeslot by using different spreading codes. This is the code-division aspect of the system. Note that each user is allocated a different spreading code and that each user bit is spread to the chip-rate as function of the employed spreading factor.

[0006] In such a system, the network allocates to each cell covered by the base stations different cell parameters which enable any mobile station attempting to establish connection to said base station to read cell broadcast information needed to communicate therewith. These cell parameters indicate for example a midamble number and a scrambling code. The midamble is a complex- or real-valued chip sequence and is used by a receiver (a mobile station in the downlink) for channel estimation which is needed for the retrieval of the user's signals. The scrambling code is used by the transmitter (a base station in the downlink) to scramble the user's signals in order to average the interference caused to user's who are sending or receiving in neigh-

boring cells.

[0007] When a mobile station gets switched on, it must first find out chip, slot and frame timing of at least one cell covering the area in which it is and then find out which midamble and scrambling code are used before it can demodulate and read the cell broadcast information. Afterwards, a tracking mechanism ensures that especially chip timing is not lost, once the mobile station is "synchronized" to the cell.

[0008] Each base station, for each cell, transmits the cell broadcast information on a channel which is generally the so-called Primary Common Control Physical Channel (P-CCPCH). It can also be the Secondary Common Physical Channel (S-CCPCH) when it is pointed to by the Primary Common Control Physical Channel P-CCPCH.

[0009] Note that a Primary Common Control Physical Channel P-CCPCH in the W-CDMA TDD system generally uses a fixed and pre-allocated spreading code with fixed spreading factor, e.g. its spreading code is the same in all cells of the W-CDMA TDD system and therefore always known before-hand by the mobile station.

[0010] A physical synchronization channel (PSCH) is also transmitted simultaneously in those timeslots in the downlink where a Primary Common Physical Channel P-CCPCH is transmitted for the purpose of synchronization to the Primary Common Control Physical Channel (P-CCPCH). The Physical Synchronization Channel essentially consists of two special signals: the primary synchronization code PSC and a set of K secondary synchronization codes SSC. The number K of secondary synchronization codes SSC is generally 3. A Primary Common Physical Channel P-CCPCH is never allocated to a particular timeslot when there is no Primary Synchronization Channel PSCH simultaneously present. If the mobile station finds out in which timeslots the Primary Synchronization Channel PSCH is sent, it knows that the Primary Common Physical Channel P-CCPCH is also in this timeslot.

[0011] Each of the K in parallel transmitted secondary synchronization code SSC spreads a symbol having a number n of states, i.e. a modulated Quadrature Phase Shift Keying (QPSK) symbol, which gives a total of n^K QPSK codewords.

[0012] On one hand, the combination of the code sets, e.g. different triplets to spread the QPSK-symbols and, on the other hand, the modulation of these QPSK-symbols are used for indicating:

- A Code Group for which are defined univocally one or several cell parameters, e.g. one or several scrambling codes together with one or several basic short or long midamble codes,
- The position of the Primary Synchronization Channel PSCH within a double-frame period, and
- The position of the current Primary Synchronization Channel PSCH timeslot within one frame.

[0013] Finally, at power-on, a mobile station first searches by performing a correlating process for the presence of the Primary Synchronization Code PSC transmitted on the Primary Synchronization Channel PSCH by the base station of the cell under the coverage of which it is and uses the found time positions for correlating with all possible secondary synchronization codes SSC, generally 16. By performing a coherent detection, e.g. using the Primary Synchronization Code PSC as a phase reference for the secondary synchronization codes SSC, it can also detect the QPSK-symbols spread by the K detected secondary synchronization codes SSC. From this information it can derive the time position of the Primary Synchronization Channel PSCH slot within the frames period as well as the Code Group to which the base station belongs. In a last step, the mobile station can demodulate a burst on the Primary Common Control Physical Channel P-CCPCH by trying all still possible of Scrambling Codes and Basic Midamble Codes which are contained in the found Code Group.

[0014] Each secondary synchronization code SSC is a different binary-valued chip sequence which is referenced by a particular index. For example, when 16 secondary synchronization codes SSC are possible in the mobile communication system, each secondary synchronization code SSC is indicated by one of the following values :

$SSC_0, SSC_1, SSC_2, \dots, SSC_{15}$.

[0015] For example, each of the secondary synchronization code SSC is formed according to the rules defined in the Technical Specifications 3GPP TSG RAN TS25.213 v320 "Spreading and Modulation (FDD)", section 5.2.3.1 page 21ff. and 3GPP TSG RAN TS25.223 v320 "Spreading and Modulation (TDD)", section 7.1 page 10ff.

[0016] Not all of the possible and available secondary synchronization codes SSC are used simultaneously in a cell for the synchronization purposes above described. Currently, for making the choice of each set of K secondary synchronization codes SSC allocated to a cell, the network takes out of the N possible ones, the first K secondary synchronization codes SSC, then the second K secondary synchronization codes SSC, etc. M out of N are chosen, the last N-M being unused. For the W-CDMA TDD system, wherein K is 3 and N is 16, for simplicity reasons, the following 4 code groups (e.g. triplets of SSC) are chosen by the network and allocated to the specific cells :

Code group 1: SSC_0, SSC_1, SSC_2
 Code group 2: SSC_3, SSC_4, SSC_5
 Code group 3: SSC_6, SSC_7, SSC_8
 Code group 4: $SSC_9, SSC_{10}, SSC_{11}$.

[0017] Thus, only $M=K \cdot L$ secondary synchronization codes SSC out of N possible and available ones are used for synchronization purposes.

[0018] The performance of the synchronization process above described is very sensible to the errors than can occur during transmission or during the correlation processes performed for the retrievals of the primary synchronization code PSC and of the secondary synchronization codes SSC.

[0019] It is an object of the invention to provide a method for allocating secondary synchronization codes SSC to a base station of a mobile telecommunication system in order to improve the performance of the synchronization process.

[0020] Generally speaking, in a system concerned with the invention, each base station continuously transmits a primary synchronization code PSC and a set of K secondary synchronization codes SSC respectively allocated to the cell covered by said base station so that any mobile station, when getting switched on, can, on basis of the primary synchronization code PSC and the set of secondary synchronization codes SSC received from said base station, synchronize with at least one base station in order to read cell parameters. Furthermore, only a predetermined and fixed number M of secondary synchronization codes SSC amongst all the N possible and available secondary synchronization codes SSC are used.

[0021] According to a feature of the invention, the method comprises the steps of calculating and evaluating the auto-correlation functions and/or cross-correlation functions of N possible secondary synchronization codes SSC and the primary synchronization code PSC and of selecting the M secondary synchronization codes SSC amongst said N possible secondary synchronization codes SSC so that said M chosen secondary synchronization codes SSC have at least one of the statistical properties of their auto-correlation function and cross-correlation function that is best in term of detection, and allocating a sub-set of said M secondary synchronization codes SSC comprising K secondary synchronization codes SSC to said base station.

[0022] Note that the auto- and cross-correlation functions can either be evaluated over the entire range, but also only over a limited window. That means that a sub-set of all possible auto- or cross-correlation values can be taken for evaluation.

[0023] It has been found that the statistical auto-correlation function properties of these synchronization codes are of primary importance for Cell Search performance as they directly impact the probability of false or erroneous detection.

[0024] Also, whenever a primary synchronization code PSC and one or more secondary synchronization codes SSC are sent in parallel, the auto-correlation function of the primary synchronization code PSC as well as the auto-correlation function of the secondary synchronization codes SSC suffer from undesired cross-correlation functions caused by the simultaneous presence of another synchronization code.

[0025] According another feature of the present in-

vention, the selection step is based upon the evaluation of any statistical property or combination of it of the following correlation functions:

- (1) auto-correlation function of each secondary synchronization code SSC
- (2) cross-correlation functions of each secondary synchronization code SSC with the primary synchronization code PSC,
- (3) cross-correlation functions of every secondary synchronization codes SSC with any other secondary synchronization code SSC.

[0026] These above criteria can be applied separately or combined.

[0027] The features of the invention appear clearly when reading the following description of some embodiments of the invention made in relation with :

Figs. 1 and 2 respectively show the auto-correlation functions of the secondary synchronization code SSC_3 and the secondary synchronization code SSC_7 and their respective cross-correlation functions with the primary synchronization code PSC, Fig. 3 shows the difference between the auto-correlation functions of the secondary synchronization code SSC_3 and the secondary synchronization code SSC_7 that can also be observed for the statistical properties of their pair-wise mutual cross-correlation functions with all other secondary synchronization codes SSC (displayed sequential order in Fig. 3), and

Fig. 4 shows tables wherein are given statistical properties of the auto-correlation functions and the cross-correlation functions of state-of-the-art synchronization codes available in a W-CDMA TDD system.

[0028] Figs. 1 and 2 respectively show the auto-correlation functions of the secondary synchronization code SSC_3 and the secondary synchronization code SSC_7 and their respective cross-correlation functions with the primary synchronization code PSC. The synchronization codes used for Figs. 1 and 2 are current state-of-the-art synchronization codes available in a W-CDMA TDD system.

[0029] From these examples, it becomes clear that the auto-correlation functions of the secondary synchronization codes SSC_3 and SSC_7 are quite different, the auto-correlation function of the secondary synchronization code SSC_3 being better in term of detection. Furthermore, the cross-correlation function of the primary synchronisation code PSC and the secondary synchronization code SSC_3 is worse in term of detection than the cross-correlation of the primary synchronization code PSC and the secondary synchronization code SSC_7 .

[0030] Fig. 3 shows the difference between the sec-

ondary synchronization codes SSC_3 and SSC_7 that can also be observed for the statistical properties of their pair-wise mutual cross-correlation functions with all other secondary synchronization codes SSC (displayed sequential order in Fig. 3).

[0031] According to one aspect of the invention, said statistical properties are one or several properties of the total energy contained by said auto-correlation functions and/or cross-correlation functions.

[0032] Statistically, the auto-correlation function can be characterized by its maximum auto-correlation side-lobe value (MAS-value), It can also be characterized by more than one values of its maximum side-lobes. It can still be characterized by the root of the mean of the total energy contained in all side-lobe peaks (RMS) value.

[0033] Similar to the auto-correlation function, the cross-correlation function can be characterized by its maximum cross-correlation peak (MCP) value, by more than one values of its maximum peaks or by the root of the mean of the energy contained by all the cross-correlation peaks (RMS) value.

[0034] Generally speaking, the detection performance of a particular synchronization code will improve, when the maximum auto-correlation side-lobe value (MAS) and the root of the mean of the energy (RMS) value of its auto-correlation function and all maximum cross-correlation peak values (MCP) and the root of the mean of the energy peaks (RMS) values of its cross-correlation with all other possible synchronization codes decrease. Choosing synchronization codes with good auto-correlation and good cross-correlation properties improves the overall Cell Search performance and as such increases the performance of the synchronization procedure and reduces mobile station processing load and its battery life.

[0035] According another feature of the invention, the method comprises the step of choosing the best L groups composed of K secondary synchronization codes SSC, such that $M=K \cdot L$, within all possible combinations out of N possible and available secondary synchronization codes SSC within the sub-set of the M used secondary synchronization codes SSC.

[0036] Note that in any case, a selection and therefore optimization of correlation properties for the sub-set of employed synchronization codes is always possible, as long as $M < N$.

[0037] According another feature of the invention, the selection step of the M secondary synchronization codes SSC comprises the steps of discarding the N-M secondary synchronization codes SSC that have at least one of the statistical properties of their auto-correlation function and cross-correlation function which are worst in term of detection and of keeping the M remaining secondary synchronization codes SSC.

[0038] Table 1, table 2 and table 3 of Fig. 4 summarize some of the statistical properties for the auto-correlation function and all cross-correlation functions of the current state-of-the-art synchronization codes which are avail-

able in the W-CDMA FDD and TDD system and that are described in the Technical Specifications 3GPP TSG RAN TS25.213 v320 "Spreading and Modulation (FDD)", section 5.2.3.1 page 21ff. and 3GPP TSG RAN TS25.223 v320 "Spreading and Modulation (TDD)", section 7.1 page 10ff.

[0039] Referring to Table 1, the selection of the $M = 12$ secondary synchronization codes SSC gives the following result when discarding the $N-M = 4$ secondary synchronization codes SSC having the worst value of the off-peak maximum auto-correlation side-lobe values (MAS) in their auto-correlation function and keeping the remaining: SSC₀, SSC₁, SSC₂, SSC₃, SSC₆, SSC₇, SSC₈, SSC₉, SSC₁₂, SSC₁₃, SSC₁₄, SSC₁₅.

[0040] When discarding the $N-M = 4$ secondary synchronization codes SSC having the worst value of the root of the mean of the energy peaks (RMS) value in their auto-correlation function and keeping the remaining, the result is: SSC₀, SSC₁, SSC₂, SSC₃, SSC₆, SSC₇, SSC₈, SSC₉, SSC₁₂, SSC₁₃, SSC₁₄, SSC₁₅.

[0041] When discarding the $N-M = 4$ secondary synchronization codes SSC having the worst maximum cross-correlation peak value (MCP) in their cross-correlation function with the primary synchronization code PSC and keeping the remaining, the result is: SSC₀, SSC₁, SSC₃, SSC₄, SSC₅, SSC₆, SSC₈, SSC₁₀, SSC₁₂, SSC₁₃, SSC₁₄, SSC₁₅.

[0042] When discarding the $N-M = 4$ secondary synchronization codes SSC having the worst value of the root of the mean of the energy peaks (RMS) in their cross-correlation function with the primary synchronization code PSC and keeping the remaining, the result is: SSC₀, SSC₁, SSC₄, SSC₅, SSC₆, SSC₈, SSC₁₀, SSC₁₁, SSC₁₂, SSC₁₃, SSC₁₄, SSC₁₅.

[0043] When discarding the $N-M = 4$ secondary synchronization codes SSC having the worst maximum cross-correlation peak value (MCP) in their cross-correlation functions with the all other secondary synchronization codes SSC and keeping the remaining, the result is: SSC₀, SSC₁, SSC₂, SSC₄, SSC₈, SSC₉, SSC₁₀, SSC₁₁, SSC₁₂, SSC₁₃, SSC₁₄, SSC₁₅.

[0044] When discarding the $N-M = 4$ secondary synchronization codes SSC having the worst value of the root of the mean of the energy peaks (RMS) in their cross-correlation function with all other secondary synchronization codes SSC and keeping the remaining, the result is: SSC₀, SSC₂, SSC₄, SSC₅, SSC₆, SSC₇, SSC₈, SSC₁₀, SSC₁₁, SSC₁₂, SSC₁₃, SSC₁₄.

[0045] According to another feature of the invention, the selection step of the M secondary synchronization codes SSC comprises the steps of selecting the best L code groups in term of detection, each group being composed of K distinct secondary synchronization codes SSC, such that $M=K*L$, out of all the N possible and available secondary synchronization codes SSC of the system.

[0046] For example, all the possible combinations of L code groups, composed each of K distinct secondary

synchronization codes SSC, such that $M=L*K < N$, are considered and the statistical properties of the auto-correlation function of the secondary synchronization codes SSC of each code group, the statistical properties of the cross-correlation functions with all other secondary synchronization codes SSC in the same and other code groups and with the primary synchronization code PSC of each is determined. Then, these properties are evaluated and compared with those of the known code groups and the best combination of L ($L = M : K$) code groups are selected.

[0047] Suppose the number N of possible secondary synchronization codes SSC of the system is 16 and that they are those shown in Table 1.

[0048] The selection of $L = 4$ sets of secondary synchronization codes SSC, composed each of $K=3$ distinct secondary synchronization codes SSC amongst the $N = 16$ possible and available secondary synchronization codes SSC of the system according to the embodiment of the selection step given below gives the following result: {SSC₁, SSC₂, SSC₃; SSC₁₂, SSC₁₃, SSC₁₄; SSC₀, SSC₆, SSC₁₅; SSC₅, SSC₈, SSC₁₁}.

[0049] According to another feature of the invention, the selection step of the M secondary synchronization codes SSC comprises the steps of selecting the best code groups in term of detection, each group being composed of K distinct secondary synchronization codes SSC out of M pre-selected, for example according to a preceding selection step of the method of the invention, secondary synchronization codes SSC.

[0050] As before, all the possible combinations of L code groups, composed each of K distinct secondary synchronization codes SSC, such that $M=L*K < N$, which can be formed from the M pre-selected secondary synchronization codes SSC are considered and the statistical properties of the auto-correlation function of the secondary synchronization codes SSC of each code groups, the statistical properties of the cross-correlation functions with all other secondary synchronization codes SSC in the same and other code groups and with the primary synchronization code PSC of each is determined. Then, these properties are evaluated and compared with those of the known code groups and the best combination of L ($L = M : K$) code groups are selected.

[0051] This process gives the following result when the pre-selected secondary synchronization codes SSC are given by discarding 4 secondary synchronization codes SSC having the worst value of the off-peak maximum auto-correlation side-lobe values (MAS) or the worst value of the root of the mean of the energy peaks (RMS) in the auto-correlation function: {SSC₂, SSC₉, SSC₁₄; SSC₆, SSC₁₂, SSC₁₅; SSC₀, SSC₁, SSC₈; SSC₃, SSC₇, SSC₁₃}.

[0052] Another solution would be: {SSC₇, SSC₁₃, SSC₁₄; SSC₆, SSC₁₂, SSC₁₅; SSC₀, SSC₁, SSC₈; SSC₂, SSC₃, SSC₉}.

[0053] When the pre-selected secondary synchronization codes SSC are given by discarding 4 secondary

synchronization codes SSC having the worst maximum cross-correlation peak value (MCP) or the worst root of the mean of the energy peaks (RMS) in their cross-correlation function with the primary synchronization code PSC : {SSC₄, SSC₆, SSC₁₀; SSC₁₂, SSC₁₃, SSC₁₄; SSC₀, SSC₁, SSC₁₅; SSC₅, SSC₈, SSC₁₁}. 5

Claims

1. Method for allocating secondary synchronization codes (SSC) to a base station of a mobile telecommunication system, each base station of said system continuously transmitting a primary synchronization code (PSC) and a set of K secondary synchronization codes (SSC) respectively allocated to the cell covered by said base station so that any mobile station, when getting switched on, can, on basis of the primary synchronization code (PSC) and the set of secondary synchronization codes (SSC) received from said base station, synchronize with at least one base station in order to read broadcast information, said system using only a predetermined and fixed number M of secondary synchronization codes (SSC) amongst all the N possible and available secondary synchronization codes (SSC), wherein it comprises the steps of calculating and evaluating the auto-correlation functions and/or cross-correlation functions of N possible secondary synchronization codes (SSC) and the primary synchronization code (PSC) and choosing the M secondary synchronization codes (SSC) amongst said N possible secondary synchronization codes (SSC) so that said the M chosen secondary synchronization codes (SSC) have at least one of the statistical properties of their auto-correlation function and cross-correlation function that is best in term of detection, and allocating a sub-set of said M secondary synchronization codes (SSC) comprising K secondary synchronization codes (SSC) to said base station. 10 15 20 25 30 35 40
2. Method according to claim 1, wherein the auto-correlation functions and/or cross-correlation functions are evaluated over the entire range. 45
3. Method according to claim 1, wherein the auto-correlation functions and/or cross-correlation functions are evaluated over a limited window. 50
4. Method according to claim 1, 2 or 3, wherein the selection step is based upon the evaluation of one or several statistical properties of the auto-correlation function of each secondary synchronization code (SSC). 55
5. Method according to claim 1, 2 or 3, wherein the selection step is based upon the evaluation of one or several statistical properties of cross-correlation function's of each secondary synchronization code (SSC) with the primary synchronization codes (PSC).
6. Method according to claim 1, 2 or 3, wherein the selection step is based upon the evaluation of one or several statistical properties of cross-correlation functions of each secondary synchronization code (SSC) with any other secondary synchronization code (SSC). 10
7. Method according to one of the preceding claims, wherein the selection step is based upon the evaluation of a combination of at least two statistical properties of the following functions : the auto-correlation function of each secondary synchronization code (SSC), the cross-correlation functions of each secondary synchronization code (SSC) with the primary synchronization code (PSC) and the cross-correlation functions of each secondary synchronization code (SSC) with any other secondary synchronization code (SSC). 15 20 25 30 35 40
8. Method according to one of claims 4 to 7, wherein said statistical properties are one or several properties of the total energy contained by said auto-correlation functions and/or cross-correlation functions. 45
9. Method according to claim 8, wherein said statistical properties are one of the following properties : one or several maximum side-lobes value, one or several maximum peaks values or the root of the mean of the total energy contained in all the side-lobe peaks. 50
10. Method according to one of the preceding claims, wherein the selection step comprises the steps of discarding secondary synchronization codes (SSC) that have at least one of the statistical properties of their auto-correlation function or cross-correlation function which are worst in term of detection and of keeping the remaining secondary synchronization codes (SSC). 55
11. Method according to claim 10, wherein the selected secondary synchronization codes (SSC) form one of the following sets :
 {SSC₀, SSC₁, SSC₂, SSC₃, SSC₆, SSC₇, SSC₈, SSC₉, SSC₁₂, SSC₁₃, SSC₁₄, SSC₁₅},
 {SSC₀, SSC₁, SSC₂, SSC₃, SSC₆, SSC₇, SSC₈, SSC₉, SSC₁₂, SSC₁₃, SSC₁₄, SSC₁₅}, {SSC₀, SSC₁, SSC₃, SSC₄, SSC₅, SSC₆, SSC₈, SSC₁₀, SSC₁₂, SSC₁₃, SSC₁₄, SSC₁₅}, {SSC₀, SSC₁, SSC₄, SSC₅, SSC₆, SSC₈, SSC₁₀, SSC₁₁, SSC₁₂, SSC₁₃, SSC₁₄, SSC₁₅}, {SSC₀, SSC₁, SSC₂, SSC₄, SSC₈, SSC₉, SSC₁₀, SSC₁₁, SSC₁₂, SSC₁₃, 50 55

SSC₁₄, SSC₁₅}, {SSC₀, SSC₂, SSC₄, SSC₅, SSC₆,
SSC₇, SSC₈, SSC₁₀, SSC₁₁, SSC₁₂, SSC₁₃,
SSC₁₄}.

12. Method according to one of claims 2 to 9, wherein the selection step comprises the step of choosing the best L groups of K secondary synchronization codes (SSC). 5

13. Method according to claim 12, wherein the selection step comprises the steps of selecting the best code groups in term of detection, each group being composed of distinct secondary synchronization codes (SSC) out of all the possible secondary synchronization codes (SSC) of the system. 10
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14. Method according to claim 13, wherein the code groups are the following :
 {SSC₁, SSC₂, SSC₃ ; SSC₁₂, SSC₁₃, SSC₁₄ ;
 SSC₀, SSC₆, SSC₁₅ ; SSC₅, SSC₈, SSC₁₁}. 20

15. Method according to one of the claim 12, wherein the selection step comprises the steps of selecting the best code groups in term of detection, each group being composed of distinct secondary synchronization codes (SSC) out of pre-selected secondary synchronization codes (SSC). 25

16. Method according to claim 15, wherein the code groups are one of the following: 30
 {SSC₂, SSC₉, SSC₁₄ ; SSC₆, SSC₁₂, SSC₁₅ ;
 SSC₀, SSC₁, SSC₈ ; SSC₃, SSC₇, SSC₁₃}, {SSC₇,
 SSC₁₃, SSC₁₄ ; SSC₆, SSC₁₂, SSC₁₅ ; SSC₀,
 SSC₁, SSC₈ ; SSC₂, SSC₃, SSC₉}, {SSC₄, SSC₆,
 SSC₁₀ ; SSC₁₂, SSC₁₃, SSC₁₄ ; SSC₀, SSC₁,
 SSC₁₅ ; SSC₅, SSC₈, SSC₁₁}. 35

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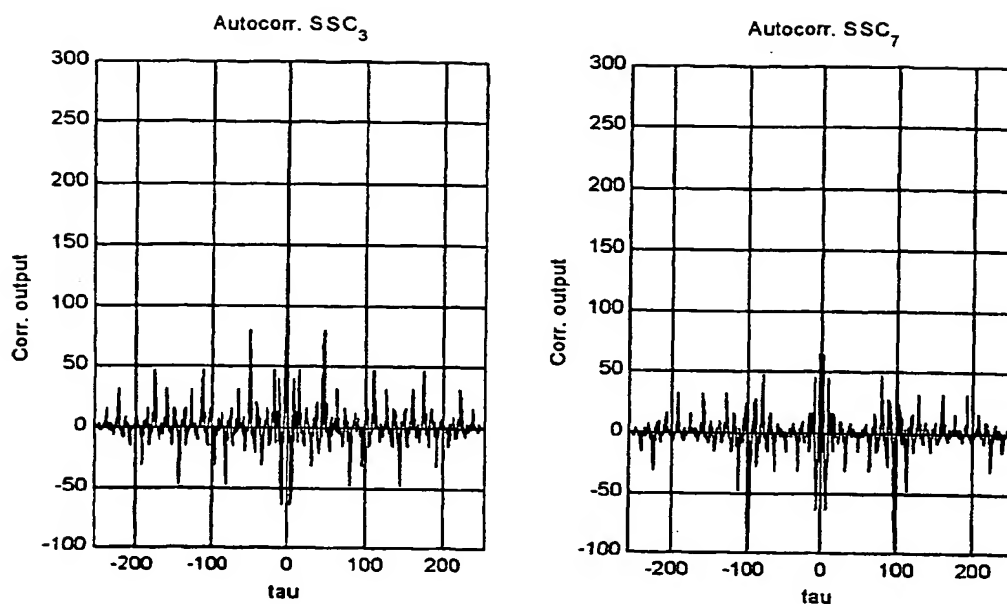


Fig. 1

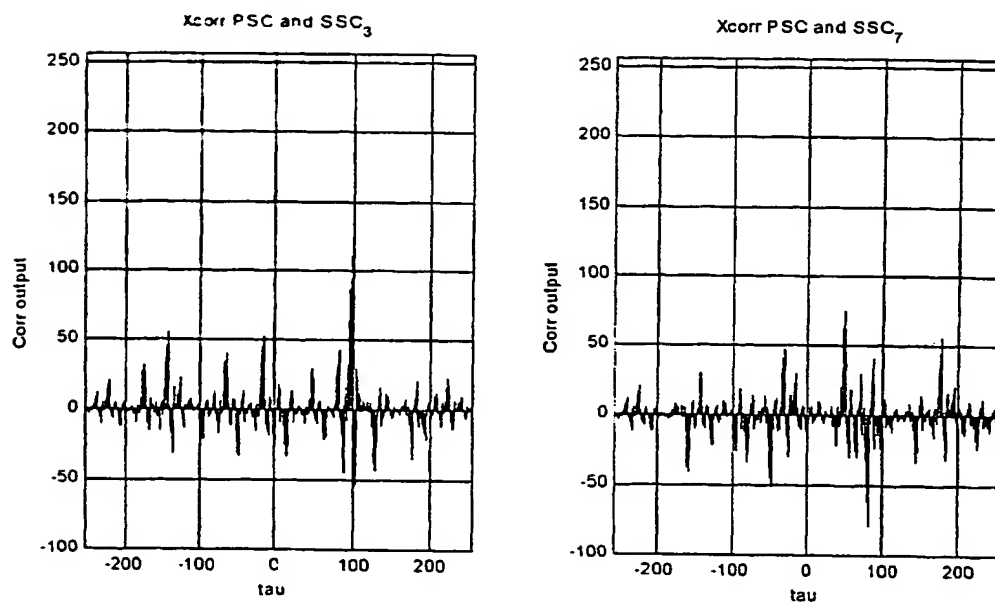


Fig. 2

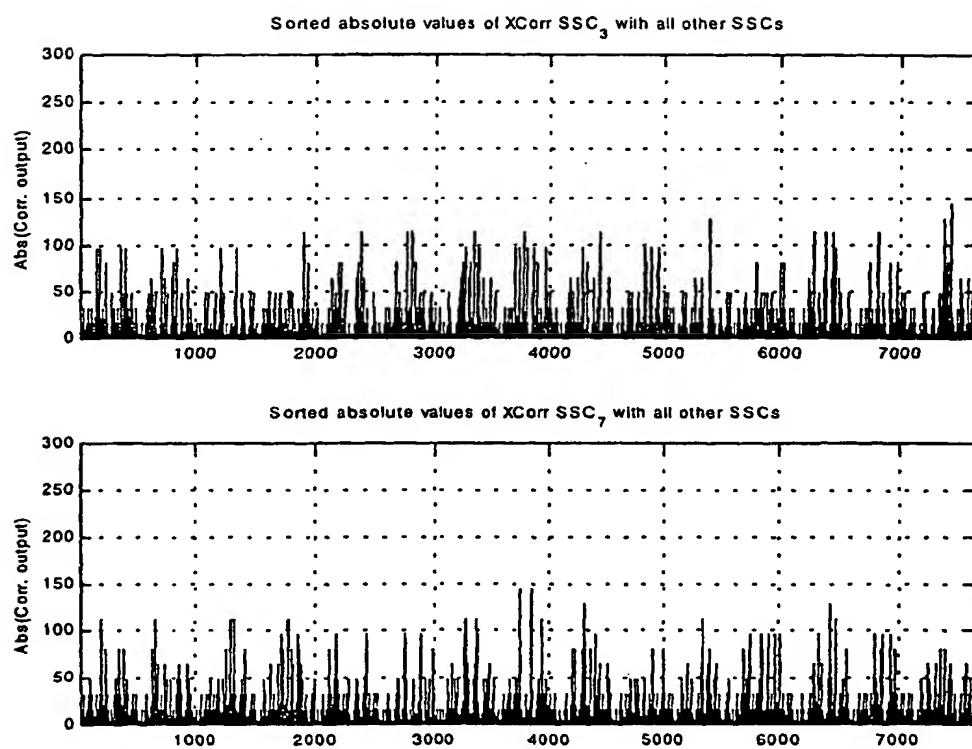


Fig. 3

	MAS of Auto-correlation (off-peak)	RMS of Auto-correlation (off-peak)
PSC	64	10.80

Table 1: Auto-correlation properties of currently available PSC in WCDMA FDD and TDD

	MAS of Auto- correlation (off-peak)	RMS of Auto- correlation (off-peak)	MCS of Cross- correlation with PSC	RMS of Cross- correlation with PSC
SSC ₀	64	12.11	81	10.49
SSC ₁	64	12.12	67	11.28
SSC ₂	80	13.93	111	12.13
SSC ₃	80	14.37	75	12.58
SSC ₄	112	15.86	89	11.90
SSC ₅	112	16.96	67	9.93
SSC ₆	96	15.26	79	11.65
SSC ₇	96	15.37	99	12.91
SSC ₈	96	13.45	83	12.10
SSC ₉	96	14.83	109	12.31
SSC ₁₀	112	15.70	77	11.24
SSC ₁₁	112	15.70	99	10.46
SSC ₁₂	80	15.20	79	11.62
SSC ₁₃	80	15.45	79	11.48
SSC ₁₄	64	10.98	77	11.87
SSC ₁₅	64	11.90	83	11.48

Table 2: Auto- and cross-correlation properties of currently available SSC's in W-CDMA FDD and TDD

	MCS of all Cross- correlation's	RMS of all Cross- correlation's
SSC ₀	144	13.29
SSC ₁	128	13.37
SSC ₂	112	13.05
SSC ₃	144	13.38
SSC ₄	128	12.90
SSC ₅	144	13.18
SSC ₆	144	13.22
SSC ₇	144	13.33
SSC ₈	144	13.08
SSC ₉	144	13.35
SSC ₁₀	144	13.04
SSC ₁₁	128	13.16
SSC ₁₂	144	13.22
SSC ₁₃	144	13.33
SSC ₁₄	144	13.23
SSC ₁₅	144	13.54

Table 3: Cross-correlation properties of each SSC with all other currently available SSC's in W-CDMA FDD and TDD

Fig. 4



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EUROPEAN SEARCH REPORT

Application Number
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